T 14: Detectors 3 (muon detectors)

Time: Monday 16:00–17:45 Location: Geb. 30.23: 3/1

T 14.1 Mon 16:00 Geb. 30.23: 3/1

The CMS Muon DT System in Run 3 : Overview & Summary — •Archana Sharma, Thomas Hebbeker, Kerstin Hoepfner, Markus Merschmeyer, Hans Reithler, and Dmitry Eliseev — III. Physikalisches Institut A, RWTH Aachen University

A high-performance muon detector system is crucial to realise the physics goals of the CMS experiment at the LHC, achieved by the highly efficient muon spectrometer, consisting of different detector technologies across different pseudorapidity (η) regions. The CMS Drift Tube (DT) chambers instrument the return yoke of CMS, being responsible for identifying, measuring, and triggering on muons in the barrel acceptance region. DTs have been running smoothly in the first two years of Run 3 with negligible contribution to the downtime/luminosity loss during the data-taking, while showing the same excellent detector performance as in Run 2. In addition, to withstand the challenging conditions of increased instantaneous luminosity and higher pileup expected during the high-luminosity LHC (HL-LHC) operation, the DT system plans for an upgrade of its electronics which will be implemented during long shutdown (LS) 3. The operation summary and performance study of the DT system carried out using the first dataset collected at a collision energy of 13.6 TeV in 2022 & 2023 is reported in this presentation. In addition, the ongoing activities for the preparation of LS 3 upgrade are summarised in brief.

T 14.2 Mon 16:15 Geb. 30.23: 3/1

New small diameter Muon Drift Tube (sMDT) Chambers and new MDT Front End Electronics for the Phase 2 Muon System Upgrade of the ATLAS Detector — •Daniel Buchin, Alice Reed, Elena Voevodina, Francesco Fallavollita, Oliver Kortner, and Hubert Kroha — Max-Planck-Institut für Physik

In order to improve the muon trigger efficiency and the rate capability of the ATLAS muon detectors for operation at the high luminosity upgrade of the Large Hadron Collider (HL-LHC), the Monitored Drift Tube (MDT) tracking chambers in the innermost barrel layer of the ATLAS Muon Spectrometer will be replaced by small-diameter Muon Drift Tube (sMDT) chambers. In addition, the electronics of the remaining MDT chambers has to be replaced by a new version able to cope with the trigger and data rates at the HL-HC. New Amplifier-Shaper-Discriminator (ASD) and new TDC chips have been developed for the new (s)MDT front-end electronics boards designed at MPP.

The sMDT chambers were in serial production between January 2021 and December 2022 at the MPP Munich. In this talk, the steps for the drift tube production and chamber construction will be presented. The stringent quality control program that assured the reliability and high mechanical precision of the chambers will be discussed as well. This includes tests of individual drift tubes, several mechanical measurements and the final certification using cosmic muons. Finally, the status of the new (s)MDT electronics designed at MPP will be discussed.

T 14.3 Mon 16:30 Geb. 30.23: 3/1

Impact of chamber deformations of the ATLAS' New Small Wheel on muon reconstruction performance — •Stefanie Götz[1], Otmar Biebel[1], Valerio D'Amico[1], Ralf Hertenberger[1], Eshita Kumar[1], Roman Lorenz[1], Katrin Penski[1], Nick Schneider[1], Patrick Scholer[2], Chrysostomos Valderanis[1], and Fabian Vogel[1] — [1]LMU München — [2]Carleton University Ottawa

Previous studies demonstrate that the New Small Wheel (NSW) chambers' residual misalignment originating from measurement uncertainties of the alignment system is small enough to allow muon reconstruction with sufficient accuracy for CERN's high luminosity upgrade of the Large Hadron Collider (LHC). However, deformations and heat expansions were assumed to have subordinate effect compared to chamber translations and rotations but they actually might have a contribution that will become relevant for further improvement of the muon momentum measurement. This study therefore investigates the behaviour of alignment uncertainties from deformations/expansions on Monte Carlo samples generated by the simulation software of the ATLAS experiment with regard to their translational/rotational equivalents/compositions. A realistic estimation for the residual uncertainties of the parameters describing deformations/expansions allows finally to evaluate the overall impact on the muon reconstructed performance.

T 14.4 Mon 16:45 Geb. 30.23: 3/1

Certification of sMDT chambers for the phase II upgrade of the ATLAS muon spectrometer — •Nick Meier, Oliver Kortner, Hubert Kroha, Elena Voevodina, Francesco Fallavollita, and Giorgia Proto — MPI für Physik, München, Deutschland

For operation at the HL-LHC, the ATLAS experiments will upgrade the inner muon spectrometer barrel layer with stations of thin-gap resistive plate chambers (RPCs) and small diameter muon drift-tube (sMDT) chambers in order to increase the acceptance of the first level muon trigger from current 80% to 95% and prevent deterioration of the spatial resolution and tracking efficiency due to high background irradiation. The MPI for Physics in Munich produced 48 sMDT chambers for this upgrade. The performance of 39 chambers after transportation to CERN was measured with cosmic-ray muons: electronics noise, muon detection efficiency, and the spatial resolution of all chambers were determined. The methods used for the certification and the results of the tests will be explained in this presentation and will be compared to the initial test campaign at MPI for Physics.

T 14.5 Mon 17:00 Geb. 30.23: 3/1

Development of a cosmic muon and neutron veto system for IAXO and BabyIAXO — •Dhruv Chouhan, Elisa Ruiz Choliz, and Matthias Schott — Johannes Gutenberg University, Mainz, Germany

The International Axion Observatory (IAXO) experiment is a large-scale helioscope aimed at searching for axions and axion-like particles (ALPs) produced in the Sun. As a first step, the BabyIAXO was proposed as a smaller scale helioscope that will reach a sensitivity on the axion-photon coupling of 1.5 x 10 $^{-11}$Gev^{-1} for masses up to 0.25 eV, covering a very interesting region of the parameter space. To detect the axion signal, a very low background x-ray detector design is required. This talk will focus on the simulation and hardware developments of the BabyIAXO veto system for cosmic rays based on light-guided organic plastic scintillators with Silicon Photo Mutiplier (SiPM) sensors.

T 14.6 Mon 17:15 Geb. 30.23: 3/1

Study of cosmogenic backgrounds in the JUNO pre-detector OSIRIS — •Marcel Büchner, Arshak Jafar, George Parker, Michael Wurm, Oliver Pilarczyk, and Tim Charisse — Johannes Gutenberg-University Mainz, Institute of Physics and EC PRISMA+

OSIRIS as the pre-detector of the JUNO reactor neutrino measurement, is meant to monitor the radio-purity of the scintillator used. The monitoring of the scintillators radio-purity relies on an in- situ measurement of radioactive decays in the 20-ton scintillator volume. Therefore, the scintillator volume is surrounded by 500 tons of water for external shielding and all detector materials have been carefully selected for radiopurity. To ensure that the background is as low as possible, OSIRIS is located approximately 700m under- ground. Even at that depth, a relevant level of background events originates from cosmic muons, which not only cause a signal themselves but they can interact with the detector material and cause the creation of radioactive isotopes. This talk presents the ongoing work of the implementation of a muon veto for OSIRIS. Utilizing an array of 12 PMTs mounted in the OSIRIS water tank but also the distinctive timing signal of muon tracks. Based on the tagging of these muons and using spatial and temporal correlations, cosmogenic neutrons and radioactive isotopes (e.g. C-11) can be identified. This Project is funded by the DFG Research Unit FOR 5519.

T 14.7 Mon 17:30 Geb. 30.23: 3/1

Plans for a neutron tagger for LEGEND-1000 — •Eric Esch for the LEGEND-Collaboration — University Tuebingen

The **L**arge **E**nriched **G**ermanium **E**xperiment for **N**eutrinoless $\beta\beta$ **D**ecay (LEGEND) is a ton-scale experimental program designed to probe the neutrinoless $\beta\beta$ ($0\nu\beta\beta$) decay of ^{76}Ge with a discovery sensitivity at half-life of more than 10^{28} years. To reach such a sensitivity, the background goal is less than 10^{-5} cts/(keV·kg·yr). Previous Monte Carlo studies for the GERDA experiment at LNGS identified the delayed decays of ^{77}Ge and its metastable state ^{77m}Ge as dominant cosmogenic background. In addressing the cosmogenic production of radioactive isotopes the potential implementation of a neutron detection system is explored. This neutron tagger will be integrated into the Water-Cherenkov-Veto. The design as well as the effects of Gadolinium on the detection efficiency is optimized using Monte Carlo simulations..